U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Pyrgulopsis notidicola*

COMMON NAME: Elongate mud meadows springsnail

LEAD REGION: Region 8

INFORMATION CURRENT AS OF: October 2005

STATUS/ACTION
___ Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, it was not elevated to Candidate status
___ New candidate
_X__ Continuing candidate
__._ Non-petitioned
__X_ Petitioned - Date petition received: May 2004
_ 90-day positive - FR date:
_ 12-month warranted but precluded - FR date:
_ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:
a. Is listing warranted (if yes, see summary of threats below)? Yes
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes
c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

The petition received in May 2004 to list all 225 candidate species, including *Pyrgulopsis notidicola* as an endangered species under the Endangered Species Act, was largely based on the present or threatened destruction, modification, or curtailment of its habitat or range, disease or predation, the inadequacy of existing regulatory mechanisms, and other natural or manmade factors affecting its continued existence (Center for Biological Diversity (CBD) *et al.* 2004). In addition, the petitioners state that these species have been on the candidate list for 17 years or more, and such delays have contributed to the extinction of many non-listed species (CBD *et al.* 2004). We considered the information contained in the petition in this assessment; however, no new substantive data on *Pyrgulopsis notidicola* was presented.

We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, emergency listings, and essential litigation-related, administrative, and program management functions. We will continue to monitor the status of this species as new information becomes available. This

review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).

___ Listing priority change
Former LP: ___
New LP: ___
Date when the species first became a Candidate (as currently defined): February 22, 2002
___ Candidate removal: Former LPN: ___
___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
___ F – Range is no longer a U.S. territory.
___ I – Insufficient information exists on biological vulnerability and threats to support listing.
___ M – Taxon mistakenly included in past notice of review.
___ N – Taxon does not meet the Act's definition of "species."
___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Class - Mollusca, Family - Hydrobiidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Humboldt County, Nevada, endemic to Soldier Meadow

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Humboldt County, Nevada, endemic to Soldier Meadow

LAND OWNERSHIP; All habitat is on public lands under the management authority of BLM.

LEAD REGION CONTACT: Debbie Pierce (CNO) 916-414-6464.

LEAD FIELD OFFICE CONTACT: Nevada Fish and Wildlife Office (Reno), Chad Mellison, 775-861-6300

BIOLOGICAL INFORMATION

Pyrgulopsis notidicola is a member of the family Hydrobiidae, which consists of approximately

about100 species of small freshwater gastropods found in the western United States. Although few studies have been conducted on species within the genus *Pyrgulopsis* (springsnails) in the Great Basin, general knowledge about their natural history exists. *Pyrgulopsis* are small (usually less than 5 millimeters [0.2 inches (in.)] high, are tightly linked with their aquatic habitat, and often are endemic to single bodies of water (particularly springs), or local drainage features (Hershler 1998). *Pyrgulopsis* are widespread within the Great Basin where they occur in a variety of relatively small, usually fishless, spring-fed water bodies. This genus also historically occurred in a few Great Basin lakes; none have been found in rivers. *Pyrgulopsis* springsnails only occupy permanent springs because they cannot survive outside an aquatic environment. Therefore, extant populations are in aquatic habitats that have persisted for long periods of geological time (Taylor 1985). It is uncommon for a spring to be occupied by more than one species of springsnail. *Pyrgulopsis* often decline dramatically in density downstream from spring sources, presumably reflecting their requirement for the well-known stable temperature, chemistry, and flow regime characterized by headsprings (Deacon and Minkley 1974). They feed on algae gleaned from the substrate and aquatic vegetation, and they occupy habitats with good water quality. Although they may occupy a number of different substrates, most species prefer either sand, gravel, or cobble (Deacon and Minkley 1974). There have been no studies on the life history of the Great Basin species.

Pyrgulopsis notidicola was described by Hershler (1998) and is distinguished from three other species in the Soldier Meadow area by its more elongate shell with short spire; larger and more disjunct aperature; well-developed columellar shelf; smaller, globose bursa copulatrix; penis with larger terminal gland; and very weak ventral gland.

Pyrgulopsis notidicola is endemic to Soldier Meadow, which is located at the northern extreme of the western arm of the Black Rock Desert in the transition zone between the Basin and Range Physiographic Province and the Columbia Plateau Province, Humboldt County, Nevada. This region is characterized by cold, dry winters influenced primarily by cool, polar air masses, and by hot, dry summers influenced primarily by warm, tropical air masses (Nachlinger 1991). Soldier Meadow lies between the Calico Mountains to the west and the Black Rock Range to the east, and encompasses a province of approximately 50 thermal, connected and isolated springs in an alluvial basin at the northwestern terminus of the Black Rock Desert about 121 kilometers (km) [75 miles (mi)] north of Gerlach, Nevada and 16 km (10 mi) south of the Summit Lake Paiute Indian Reservation. The vegetation is broadly classified into four wetland communities and three upland communities, one of which is considered transitional. The wetland communities support a tremendous diversity of plants, with over 60 different species identified in the marshes, seeps, and meadows. Thermal springs occur in the area at elevations ranging from 1,320 and 1,393 m (4,330 and 4,570 ft) (Nachlinger 1991). Some of the springs provide the only known habitat for the desert dace (*Eremichthys acros*), a federally-listed species endemic to approximately 20 springs in Soldier Meadow (Knight 1990).

The only ecological data compiled on this species were collected by Donald W. Sada (Associate Research Professor, Desert Research Institute, pers. obs. 1996) and Sada and Powell (2001). This species occupies two basic habitat types. The first type is near the source of springs with

temperatures greater than 45^{o} Celsius (C) [113^{o} Fahrenheit (F)]. In this habitat, the species occupies the splash zone on rocks and riparian grasses. It occupies habitats occurring only in wetted areas within 1 centimeter (0.4 in.) of the water. In these high temperatures, it is semi-aquatic and not submerged. The second type of habitat occurs where the temperature decreases down stream from spring sources. In this habitat, the species disappears from the splash zone and becomes submerged, limiting itself to gravel substrate in riffles. It does not occupy sites with low current velocity or habitats with fine substrates. Total amount of occupied habitat includes one spring providing less than 300 meters (m) [984 feet (ft)] of habitat. Sada and Powell (2001) estimated that the density of snails per 25 square centimeters (cm^2) (4 square inches (in^2) ranged from 0 to 27 [mean 2.7 to 13.0/25 cm^2 (4 in^2)] in riffle habitats with gravel substrate. They were absent from ponded areas with fine substrate.

Distribution

Pyrgulopsis notidicola was first collected by J.J. Landye in Soldier Meadow during 1978 (Hershler 1998) and populations that he collected were extant during 1996 surveys by Sada (pers. obs. 1996). The absence of early distributional surveys make it impossible to determine how current distribution and abundance of *Pyrgulopsis notidicola* compares with historical conditions. *Pyrgulopsis notidicola* is currently known from one unnamed spring in Soldier Meadow. Extensive surveys in the Soldier Meadow region that have not recorded any observations outside its restricted range (D. Sada, pers. obs. 1996; Hershler 1998). Although several springs in the region are occupied by other *Pyrgulopsis* spp., *Pyrgulopsis notidicola* has not been located in these. The type locality, and the only known location of the species, occurs is an unnamed spring in the Mud Meadow drainage within the Soldier Meadow complex. This area is the northernmost of a large series of thermal springs having broad outflows.

Pyrgulopsis notidicola occurs only in a stretch of thermal aquatic habitat that is approximately 300 m (984 ft) long and 2 m (6.7 ft) wide (Sada and Powell 2001). Water depths in unaltered portions of the spring brook do not exceed 15 cm (6 in.) and substrate composition includes sand, gravel, and cobble. Current velocity varies from 0 (along the banks) to 40 cm/sec (16 in./sec) in mid-channel (Sada and Powell 2001). All substrate in bathing impoundments along this spring brook is composed of silt and sand; water depth is usually greater than 50 cm (20 in.); and current velocity is 0 cm/sec. Riparian vegetation along the spring brook is dominated by sedges and rushes. Woody vegetation is absent. Water temperature decreases downstream from the spring source and *Pyrgulopsis notidicola* becomes decreasingly abundant where temperatures drop below 32^{o} C (90^{o} F) degrees (Sada and Powell 2001).

Population Estimates/Status: No quantitative monitoring of the *Pyrgulopsis notidicola* population has occurred in the past year. On May 13, 2004 the BLM intensively surveyed the *Prygulopsis notidicola* habitats to collect baseline information on the number and condition of the human built dams within the complex. Over 30 dams were documented with over half being inactive (many were broken and did not impound water or they were silted in with bullrushes dominating the remnant pools) (M. Varner, BLM Fisheries Biologist, pers. comm., 2004). In addition to collecting spatial and physical information on the dams, other physiochemical data were collected. Overall, data that were collected included pool length, pool depth, depth profile,

max depth, dam height, dam width, UTM coordinates, photo points (up, across, down), temperature, conductivity, and general comments about the channel and adjacent riparian area. These data were entered into a GIS database and a report was submitted to the USFWS in July, 2004.

THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

The springs inhabited by *Pyrgulopsis notidicola* are on public lands managed by the U.S Bureau of Land Management (BLM). The top four recreational uses of Soldier Meadow listed in order are: bathing in hot springs, camping, all-terrain vehicle travel, and four wheel driving. This area has some of the most desirable campsites in the entire Black Rock Desert National Conservation Area (NCA). People are drawn to the area by the hot springs, several of which are at an ideal temperature for bathing, and the quiet and solitude of the area. Most visitors to the area have little or no knowledge of the occurrence of springsnails. The sites used for bathing are highly disturbed. Because the spring brook is relatively shallow, bathers have constructed impoundments to increase the depths to a point suitable for bathing (BLM 1998).

Vehicle counts and observed visitor use data show that during the summer of 1990, approximately 2,800 people visited the Black Rock Desert. Between 1994 and 1995, visitor use had increased by 4,000 12-hour visitor days (Bureau of Land Management (BLM) 1998). By 2001, dispersed recreational users increased to nearly 70,000 (BLM 2003). The highest use of Soldier Meadow occurs on Memorial Day weekend and the opening day of chukar hunting season; in 2003, about 26 separate hunting camps were counted with an estimated 100 people (R Farschon, pers. comm., 2005). The visibility of the area has also increased since the designation of the Black Rock Desert-High Rock Canyon Emigrant Trails National Conservation Area (NCA) in 2000 (R. Farschon, pers. comm. 2002; BLM 2003). In the fall of 2004, the BLM constructed a central campground away from the habitats for sensitive species at Soldier Meadow (M. Varner, pers. comm., 2005).

Sada and Powell (2001) found *Pyrgulopsis notidicola* occurs only in shallow, flowing water on gravel substrate. The species does not occur in deep water (i.e. impoundments) where water velocity is low, gravel substrate is absent, and sediment levels are high. Deep water habitats do not occur naturally in *Pyrgulopsis notidicola* habitat. Examination of its habitat use along its 300 m (984 ft) range, showed that the species is absent from impoundments that have been constructed for recreational bathing. The fact that *Pyrgulopsis notidicola* is found above and below these constructed impoundments suggests that their construction is eliminating habitat for this species and reducing its historic range. In the last 10 years, the number of impoundments have doubled to over a dozen. More studies are needed to determine the proportion of historic habitat that these impoundments impact. Bathers also adversely impact habitat by increasing sedimentation through stream bank trampling and removal of vegetation. The placement of various materials to increase the comfort of the bathers (e.g., carpet) in the spring brook and on its banks also adversely impacts *Pyrgulopsis notidicola* and its habitat. Post Burning Man event cleanup by BLM staff in 2000, resulted in the removal of impoundments, large pieces of carpet

which had been placed on the banks and in the spring brook, and other various materials which had been left behind in the spring brook by recreationalists (Laura Berglund, pers. obs. 2000). Additional cleanup was undertaken by BLM in 2005 at the most popular bathing pools. All carpet, plywood and other man made debris was removed. Flat rocks were handplaced to form level platforms for bathers and eliminate the tendancy for users to place carpet or plywood at the pool edges. Concentrated, overnight use of the area, and the lack of sanitary facilities could also be resulting in impacts to water quality.

The Soldier Meadow area was subject to intensive geothermal exploration in the 1970s. The maximum temperature of the aquifer was deemed insufficient to support economic development at that time. The enabling legislation for the Black Rock-High Rock NCA withdrew the entire NCA, including public lands at Solider Meadows for all forms of mineral development.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

Not known to be a threat to *Pyrgulopsis notidicola* at this time.

C. Disease or predation.

Not known to be a threat to *Pyrgulopsis notidicola* at this time.

D. The inadequacy of existing regulatory mechanisms.

Approximately 841 hectares (2077 acres) of public land surrounding some of the habitat of the desert dace (*Eremichthys acros*) was designated by the BLM as the Soldier Meadows Area of Critical Environmental Concern (ACEC). The ACEC initially encompassed 124 hectares (307 acres) and was designated to highlight the area where special management attention is needed to protect and prevent irreparable damage to important biological, cultural, and historic resources. In 2004, the ACEC was increased to its current size to provide more protection and management focus on the desert dace, springsnails, and Soldier Meadow cinquefoil (*Potentilla basaltica*), a rare plant species known only from Soldier Meadow and an area in northeast California. It is also designated as a BLM Research Natural Area (RNA). An RNA is an area which contains natural resource values of scientific interest and is managed primarily for research and educational purposes. Although these designations encompass the entire range for the species, they have not been sufficiently implemented to fully protect *Pyrgulopsis notidicola*.

In 1998, BLM completed the Soldier Meadow Activity Plan (SMAP) and Environmental Assessment (Plan). The preferred alternative within the Plan is designed to: 1) address impacts to special status species and cultural resources from increased recreation, livestock, wild horse and burro grazing, and potential geothermal and mineral development; 2) implement management actions to provide favorable habitat conditions for desert dace that will enable the Service to delist the species; 3) implement management actions to protect habitat for Soldier Meadow cinquefoil so the Service will not need to list the species; and 4) implement management actions to protect cultural resources in the area from further degradation. Specific actions identified in the Plan include: monitoring area use, increasing law enforcement,

designating visitor use areas, designating specific bathing pools with walk-in access, limiting camping, limiting vehicle parking and camping within 61 m (200 ft) of the spring brook, developing interpretive signs, and dismantling impoundments in nondesignated bathing areas. These actions could help conserve the species and its habitat if fully implemented.

Some portions of this Plan have been implemented including increased recreational area use monitoring and enforcement. This occurs mainly during holiday weekends or major events, such as the Burning Man Festival. However, limited resources and the remote nature of the site have made it difficult to implement most of the specific actions. Almost five years have passed since the Plan was finalized, yet visitor use bathing areas have not been designated, allowing for continued dispersed use of the area which negatively impacts *Pyrgulopsis notidicola* and its habitat.

In 2004, the Black Rock/High Rock Resource Management Plan (RMP) was finalized which incorporates implementation of the SMAP under the proposed action. The Biological Opinion written for the RMP recommended that the BLM expedite review, update, and implement the SMAP, and coordinate with the Service to develop a schedule for planning, implementation, and consultation (USFWS 2004). Also in 2004 BLM completed a 3,000 acre exclosure at Soldier Meadows which includes known populations of *Pyrgulopsis notidicola*. The purpose of the fence was to eliminate livestock and wild horse grazing from the hot springs and associated spring brooks.

In 2005 BLM was able to obtain a volunteer site steward for the six month primary public use period. The steward was able to directly interact with visitors and provided an additional mechanism to provide public outreach.

E. Other natural or manmade factors affecting its continued existence.

Spring-dwelling species in the western United States are vulnerable to unpredictable events, which have caused decline and extirpation of many populations (Sada and Vinyard 2002). Habitats occupied by springsnails are often small, unique, habitats where environmental conditions are predictable and stochastic events are rare. However, the small size of their habitats and their limited range (many are endemic) makes them highly susceptible to any factors that negatively impact their habitat. Other spring-dwelling species have been particularly vulnerable to habitat alteration by diversion and to introduction of predaceous and competitive non-native species (Williams et al. 1985; Sada and Vinyard 2002).

Because of its extremely limited range (less than 300 m (984 ft) of spring brook), *Pyrgulopsis notidicola* is highly susceptible to extinction if factors in its environment become unfavorable. *Pyrgulopsis notidicola* cannot withstand dessication for more than a few hours and does not have the ability to migrate to other suitable habitats. Its inability to withstand dessication also means that any impacts, such as water diversions that would result in drying of its habitat, could result in extinction. This is possible even if the impact is temporary.

Introductions of non-native species result from intended management actions or accidental

introduction by fisherman and recreational bathers. The red-rimmed thiara (*Melanoides tuberculata*) and New Zealand mudsnail (*Potamopyrgus antipodarum*) are two species in western Nevada and eastern California that may be introduced into Soldier Meadow in the future. Both of these species are hardy, tolerant of surviving dry conditions of extended periods, and both have been transported in moist clothing or footwear. Hershler and Sada (1987) observed decreased springsnail abundance in habitats occupied by the thiara in other areas, and the mudsnail was recently established in nearby California where it has rapidly dominated the macroinvertebrate community. Continued use of *Pyrgulopsis notidicola* habitat by bathers provides a continuing threat that these species may be accidentally introduced.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

The BLM has issued a Record of Decision on the Resource Management Plan (RMP) and Final Environmental Impact Statement for the Black Rock Desert-High Rock Canyon Emigrant Trails NCA, which encompasses the Soldier Meadow area, which address many of these issues (BLM 2003). In accordance with the terms of the 2004 Final Multiple Use Decision for the Soldier Meadows Allotment, the area has been fenced to exclude livestock, wild horses, and burros from the majority of *Potentilla basaltica*, desert dace, and *Pyrgulopsis notidicola* habitats (BLM 2004b).

In May 2004, the BLM completed the Soldier Meadows Recreation Management Plan (BLM 2004a). The management plan implemented numerous conservation actions identified in the RMP for the listed and candidate species of Soldier Meadows including closing of access roads to the spring, riparian and wetland areas, the limiting of Off Highway Vehicles to designated roads and trails, the establishment of a central campground away from sensitive habitats, and the implementation of a monitoring program to assess the effects of these actions on listed, candidate, and sensitive species. It also included the installation of educational signage and increased presence of BLM staff, including law enforcement and a site steward during the summer camping season. All of these actions, with the exception of the monitoring program, were fully implemented over the past year and are reported to have been successful at reducing recreational impacts to the habitats of sensitive species, including that of *Pyrgulopsis notidicola* (Matt Varner, personal communication, 2005). A monitoring plan is being drafted to evaluate the impacts of land use on the rare species in Soldier Meadows, including *Pyrgulopsis notidicola*. The plan should be completed in 2006.

SUMMARY OF THREATS

The present or threatened destruction, modification, or curtailment of its habitat or range by recreational bathers in the thermal waters is the greatest threat to the species. The small size of their habitat and their limited range makes them highly susceptible to any factors that negatively impact their habitat. Regulatory mechanisms are beginning to be put in place but few actions have been implemented to date. Without monitoring data that shows both short- and long-term effects of current management, it would be premature to remove *Pyrgulopsis notidicola* from candidate status.

RECOMMENDED CONSERVATION MEASURES

Short-term and long-term monitoring of the effects of current management on *Pyrgulopsis notidicola* should be implemented as soon as possible. The monitoring should identify specific indicators that will be monitored, set clear management objectives, and specify the management response given a range of alternative results (Kershner 1997). Following BLM guidance on conserving springs should be a priority in the Soldier Meadows area (BLM 2001). Other actions required on an annual basis, such as increased staff presence and campground hosting should be continued. Compliance with the designated route system should also be monitored.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	**2**
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: Although the Soldier Meadows Recreation Management Plan was completed in May 2004, and several conservation actions (see conservation measures discussion) were implemented, the monitoring component has not been implemented to date. Until a monitoring plan is drafted and implemented, there is only anecdotal information on the success of the conservation actions and the reduction in the magnitude of threats. For example, on opening day of chukar hunting season in 2003, about 26 multi-unit hunting camps were counted in Soldier Meadows. Additionally, there have been reports of people using bleach to disinfect some of the pools. If bleach is increasingly used by bathers, the potential for adverse impacts to the species is high. High demand for limited thermal resources results in communal use and the construction of additional dams to create more soaking pools. Given the lack of regulations guiding the use of this area and the absence of full time enforcement personnel and/or campground hosts, we believe the magnitude of the threats is high.

Imminence: Adverse modification of *Pyrgulopsis notidicola* habitat has occurred for many years and continues to be the primary threat to its existence. Although BLM has developed a

recreational plan for the area and a project was completed to fence 3000 acres of Soldier Meadows, including all of the *Pyrgulopsis notidicola* habitat, monitoring of these actions have yet to be implemented and proven effective in addressing the threats to the species. Therefore, the Service considers the threats imminent.

Rationale for Change in Listing Priority Number (insert if appropriate)

___ Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed? Yes

Is Emergency Listing Warranted? The ACEC, SMAP, RMP, and recreation plan should provide enough protection for the species if they are fully implemented. The Service will continue to monitor the implementation of these plans and evaluate their effectiveness. BLM is continuing to monitor habitat conditions and unless additional habitat destruction or water quality issues arise, emergency listing is not warranted at this time.

DESCRIPTION OF MONITORING

No quantitative monitoring of the *Pyrgulopsis notidicola* population has occurred in the past year. On May 13, 2004 the BLM intensively surveyed the *Prygulopsis notidicola* habitats to collect baseline information on the number and condition of the human built dams within the complex. Over 30 dams were documented with over half being inactive (many were broken and did not impound water or they were silted in with bullrushes dominating the remnant pools) (M. Varner, BLM Fisheries Biologist, pers. comm., 2004). In addition to collecting spatial and physical information on the dams, other physiochemical data were collected. Overall, data that were collected included pool length, pool depth, depth profile, max depth, dam height, dam width, UTM coordinates, photo points (up, across, down), Temperature, Conductivity, and general comments about the channel and adjacent riparian area. These data were entered into a GIS database and a report was submitted to the USFWS in July, 2004. BLM contracted with Dr. Robert Hershler of the Smithsonian Institute to complete a taxonomic survey of springsnails in Soldier Meadows. Field surveys were conducted in August 2005 and samples were delivered to the Smithsonian for identification. This will provide information identifying springs occupied by specific species of springsnails in Soldier Meadows and when complete, will confirm whether or not additional sites for *Prygulopsis notidicola* exist.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Indicate which State(s) did not provide any information or comments: Nevada

LITERATURE CITED

Bureau of Land Management. 2004. Environmental Assessment for the Soldier Meadows

Recreation Management Plan, NV-020-04-26, Winnemucca Field Office, Winnemucca, Nevada. 78 pp.

Bureau of Land Management. 2004. Final Multiple Use Decision for the Soldier Meadows Allotment. Winnemucca Field Office, Winnemucca, Nevada.

Bureau of Land Management. 2003. Proposed Resource Management Plan and Final Environmental Impact Statement for the Black Rock Desert-High Rock Canyon Emigrant Trails National Conservation Area (NCA) and Associated Wilderness and Other Contiguous Lands in Nevada; Volumes 1, 2, and 3. Winnemucca Field Office, Winnemucca, Nevada, and Surprise Field Office, Cedarville, California.

Bureau of Land Management (BLM). 2001. Riparian area management: A guide to managing, restoring, and conserving springs in the Western United States. Technical Reference 1737-17. Bureau of Land Management, Denver, Colorado. BLM/ST/ST-01/001+1737. 70 pp.

Bureau of Land Management. 1998. Final Soldier Meadow Activity Plan and Environmental Assessment. Winnemucca District, Winnemucca, Nevada. 61 pp. + appendices.

Center for Biological Diversity, J. Goodall, E.O. Wilson, P. Ehrlich, J. Terborgh, N. Eldredge, T. Eisner, R. Hass, B. Kingsolver, C. Bowden, M. Sheen, the Xerces Society, and Biodiversity Conservation Alliance. 2004. Petition to list 225 plants and animals as endangered species under the Endangered Species Act. Submitted to the Secretary of Interior, May 11, 2004.

Deacon, J. E. and W. L. Minckley. 1974. Desert fishes. Pp. 385-487 in G. W. Brown, Jr. (ed.), in Desert Biology. Special Topics on the Physical and Biological Aspects of Arid Regions. Volume II. Academic Press: New York.

Hershler, R. 1998. A systematic review of the hydrobiid snails (Gastropoda: Rissoidea) of the Great Basin, western United States. Part I. Genus Pyrgulopsis. The Veliger 41:1-132.

Hershler, R. and D.W. Sada. 1987. Springsnails (Gastropoda: Hydrobiidae) of Ash Meadows, Amargosa basin, California-Nevada. Proceedings of the Biological Society of Washington, 100:776-843.

Kershner, J. L. 1997. Monitoring and adaptive management. Pages 116-131 in J.E. Williams, C.A. Wood, and M.P. Dombeck, editors. Watershed Restoration: Principles and Practices. American Fisheries Society, Bethesda, Maryland.

Knight, T.A. 1990. Status report: Potentilla basaltica Tiehm and Ertter. Unpublished report prepared for the U.S. Fish and Wildlife Service, Reno, Nevada. 25 pp.

Nachlinger, J. 1991. Ecological survey of Soldier Meadow, Humboldt County, Nevada. Unpublished report prepared for the Bureau of Land Management, Winnemucca, Nevada. 26 pp.

Sada, D.W. and H. Powell. 2001. Distribution, abundance, and habitat use of Soldier Meadow springsnails (Family Hydrobiidae). Unpublished report to U.S. Bureau of Land Management, Winnemucca, NV.

Sada, D.W. and G.L. Vinyard. 2002. Anthropogenic changes in historical biogeography of Great Basin aquatic biota. Pages 277-292, *in*, R. Hershler, D.B. Madsen, and D.R. Currey (eds.). Great Basin Aquatic Systems History. Smithsonian Contributions to Earth Sciences, Number 33.

Taylor, D. W. 1985. Evolution of freshwater drainages and molluscs in Western North America. Pages 265-321, *in*, C,J, Hocutt and A.B. Leviton (eds.). Late Cenozoic History of the Pacific Northwest. American Association for the Advancement of Science and California Academy of Science, San Francisco.

U.S. Fish and Wildlife Service. 2004. Final Biological and Conference Opinions on the Proposed Resource Management Plan for the Black Rock Desert-High Rock Canyon Emigrant Trails National Conservation Area NCA and Associated Wilderness, and Other Contiguous Lands in Nevada. Nevada Fish and Wildlife Office, Reno, Nevada.

U.S. Fish and Wildlife Service. 1997. Recovery Plan for the Rare Species of Soldier Meadows. Portland, Oregon. 50 pp.

Williams, J.E., D.B. Bowman, J.E. Brooks, A.A. Echelle, R.J. Edwards, D.A. Hendrickson, and J.J. Landye. 1985. Endangered aquatic ecosystems of North American deserts with a list of vanishing fishes of the region. Arizona-Nevada Academy of Science 20:1-62.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: /s/ Paul Henson April 26, 2006
Acting CNO Manager, Fish and Wildlife Service Date

Concur: _____ August 23, 2006
Acting Director, Fish and Wildlife Service Date

Do not concur: _____
Director, Fish and Wildlife Service Date

Date of annual review: October 2005
Conducted by: Steve Caicco